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# Masked hypertension

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Masked hypertension is diagnosed if the office blood pressure reading is not increased but the out-of-office-blood pressure reading by either home blood pressure monitoring or by ambulatory blood pressure monitoring is increased (1-3). Patients being treated for hypertension who have a normal office blood pressure reading but an increased out-of-office-blood pressure reading by either home blood pressure monitoring or by ambulatory blood pressure monitoring should be diagnosed as having masked uncontrolled hypertension (1). The European Society of Hypertension diagnosed an increased office blood pressure if the blood pressure was 140/90 mm Hg or higher and an increased out-of-office-blood pressure if the home blood pressure reading was 135/85 mmHg or higher, the daytime blood pressure reading measured by ambulatory blood pressure monitoring was 135/85 mmHg or higher, or the 24-hour ambulatory blood pressure reading was 130/80 mmHg or higher (1). On the basis of current data, I would diagnose hypertension if the office systolic blood pressure was 130 mmHg or higher or if the office diastolic blood pressure was 80 mmHg or higher (4,5).

Masked hypertension might be suspected in persons with an increased office blood pressure at some time, in young persons with normal or high normal office blood pressure who have left ventricular hypertrophy, in persons who have a family history of hypertension in both parents, in diabetics, in persons with multiple cardiovascular risk factors, and in obese individuals (1). Masked hypertension is estimated to occur in 10% to 30% of persons (1). Masked hypertension was diagnosed by ambulatory blood pressure monitoring in 14% of persons and by home blood pressure monitoring by 11% of persons (6). It may be reasonable to screen for masked hypertension with ambulatory

blood pressure monitoring or with home blood pressure monitoring if the office systolic blood pressure is 120 to 129 mmHg or if the office diastolic blood pressure is 75 to 79 mmHg (6-10).

The prevalence of masked uncontrolled hypertension in 14,840 persons with treated hypertension in a Spanish registry was 31.1% (3). The prevalence of masked uncontrolled hypertension was higher in men, in persons with a borderline office blood pressure, and in smokers, diabetics, and obese persons (3). Of 5,007 persons with untreated hypertension, 8.1% had masked hypertension (6). Of 1,451 persons in this study with treated hypertension, 16.0% had masked uncontrolled hypertension. At 8.3-year median follow-up, cardiovascular events in those with untreated hypertension were increased 55% in persons with masked hypertension and 2.13 times in persons with sustained hypertension. Cardiovascular events in persons with treated hypertension were increased 76% in persons with masked hypertension and 40% in persons with uncontrolled hypertension (6).

Of 332 persons, 22% had masked hypertension (7). Left ventricular mass index, carotid maximal intima-media thickness, and urinary albumin level were higher in persons with masked hypertension than in persons with controlled hypertension and similar to those with sustained hypertension (7). A meta-analysis of seven studies including 11,502 persons, mean age 63 years, showed at 8.0-year follow-up that compared to normotensive persons, persons with masked hypertension had a 2.0 times increase in first cardiovascular events, and persons with sustained hypertension had a 2.28 times increase in first cardiovascular events (8).

A meta-analysis of eight studies including 7,964 persons showed that compared to normotensive persons, persons

with masked hypertension had at follow-up a 2.09 times increase in cardiovascular events, and persons with sustained hypertension had a 2.59 times increase in cardiovascular events (9). In 8,237 untreated persons, mean age 50.7 years, in 12 population studies, the prevalence of masked hypertension ranged from 9.7% to 19.6% (10). At follow-up, compared to normotensive persons, persons with masked hypertension had a 1.76 to 2.03 times increase in cardiovascular events (10).

Of 1,332 Japanese persons, 16.6% had masked hypertension (11). At 10-year follow-up, compared to normotensive persons, persons with masked hypertension had a 1.88 times increased risk of cardiovascular disease mortality, a 2.17 times increased risk of stroke, and a 2.13 times increase in risk of cardiovascular disease mortality and stroke (11). Compared to normotensive persons, persons with sustained hypertension had a 1.94 times increased risk of cardiovascular disease mortality, a 2.83 times increased risk of stroke, and a 2.26 times increase in risk of cardiovascular disease mortality and stroke (11). Of 3,027 persons, mean age 47 years (50% blacks), in the Dallas Heart Study, 17.8% had masked hypertension (12). Persons with masked hypertension had increased aortic pulsed wave velocity, cystatin C, and urinary albumin-to creatinine ratio. At 9.0-year median follow-up, after adjusting for traditional cardiovascular risk factors, compared with normotensive persons with masked hypertension had a 2.03 times increased risk of cardiovascular events, and persons with sustained hypertension had a 3.12 times increased risk of cardiovascular events (12).

In 972 blacks, mean age 60 years, in the Jackson Heart Study, masked hypertension was present in 25.9% of persons and in 34.4% of persons with a normal clinic blood pressure (13). Male gender, smoking, diabetes mellitus, and use of antihypertensive drugs were independent determinants of masked hypertension. Common carotid artery intima-media thickness, left ventricular mass index, and the urinary albumin to creatinine excretion ratio were higher in persons with masked hypertension than in persons with normal blood pressure and similar in persons with masked hypertension and with sustained hypertension (13). Fewer modifiable cardiovascular risk factors measured by the American Heart Association Life's Simple 7 was associated with a lower prevalence of masked hypertension in the Jackson Heart Study (14). In 644 participants in the Jackson Heart Study, the 10-year predicted atherosclerotic cardiovascular disease (ASCVD) risk was increased by

masked hypertension 1.36 times by the pooled cohort risk equation if the ASCVD risk was 5% to 7.4%, 1.62 times if the ASCVD risk was 7.5% to 9.9%, and 1.91 times if the ASCVD risk was  $\geq 10\%$  (15).

Of 5,636 Canadian persons with hypertension treated in a primary care setting, 19.6% and 36.8% of persons with controlled office blood pressure had masked uncontrolled hypertension (16). Diabetes mellitus, older age, male gender, obesity, and higher office systolic blood pressure were associated with masked uncontrolled hypertension (16). Of 803 persons, mean age 60 years, with treated and controlled office blood pressure, 32.1% had masked uncontrolled hypertension (17). Masked uncontrolled hypertension was due to increased nocturnal blood pressure in 22.3% of persons and to poor daytime blood pressure increase in 10.1% of persons. Masked uncontrolled hypertension was associated with male gender, longer duration of hypertension, obesity, smoking, and diabetes mellitus (17). Using data from 9,316 persons in the National Health and Nutrition Examination Survey 2005–2010, the estimated prevalence of masked hypertension in the United States was 12.3% of adults (18). Masked hypertension was higher in older persons, men, diabetics, and those with prehypertension (18).

In 813 participants, mean age 45 years, without treated hypertension in the Masked Hypertension Study, 15.2% had masked hypertension (19). Echocardiographic left ventricular mass index was higher in persons with masked hypertension and in persons with prehypertension (19). In 652 Swiss persons, mean age 48 years, masked hypertension was present in 15.8% of persons (20). Masked hypertension was associated with age (odds ratio = 1.02), high-normal office blood pressure (odds ratio = 6.68), and with obesity (odds ratio = 3.63) (20). In 588 Chinese patients with non-dialysis chronic kidney disease, mean age 43 years, 20.6% of patients had masked hypertension (21). At 35-month median follow-up, masked hypertension increased all-cause mortality 8.88 times, renal events 3.70 times, and major adverse cardiac and cerebrovascular events 8.66 times (21).

Nocturnal hypertension and non-dipping may be early markers of masked hypertension (22). Twenty-four hour ambulatory monitoring is the gold standard for diagnosing masked hypertension. Almost one-third of treated patients with masked hypertension have masked uncontrolled hypertension (22). There are scarce data on how to treat masked hypertension (23). One approach to treating masked hypertension would be to treat 24-hour ambulatory blood pressure (23). I would also aggressively treat modifiable

risk factors for masked hypertension. Although I would treat masked hypertension because of its association with increased cardiovascular and cerebrovascular events and mortality, we do not have clinical trial data demonstrating that treating masked hypertension will reduce cardiovascular and cerebrovascular events and mortality. Since masked hypertension may be a prognostic marker of adverse cardiovascular and cerebrovascular events and mortality, clinical trials need to be performed to investigate whether masked hypertension should be treated with antihypertensive drug therapy.

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## Footnote

*Conflicts of Interest:* The author has no conflicts of interest to declare.

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